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Opportunities for Methane Emission Reduction Projects at Surface Coal Mines

2008 Coal Mine Methane Conference

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Presentation Outline

- Differentiate between CBM and CMM pre-drainage
- Baseline Methodology
- Summary of Powder River Basin Activities
- Opportunities Outside the PRB

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CBM or CMM Project?

- CBM & CMM pre-drainage go hand-and-hand
  - Pre-drainage wells located near underground coal mines are essentially CBM wells located within planned mining activities
  - Pre-drainage outside of mine typically does not occur outside of proven CBM fields (e.g., Piceance, Illinois basins)
- Vertical limits imposed on eligible wells
  - Emission reductions generated from wells completed in horizons between 150 meters above and 50 meters below the mined seam

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CBM or CMM Project?

- Gas developer often separate entity from coal mine company
  - El Paso & Geomet in Alabama (pre-drainage)
  - Dominion in Northern Appalachia (gob)
- Coal mine often does not have ownership of gas rights
  - Severed mineral rights
- Cooperation between coal mine and gas developer is needed
  - Important to know location of wells

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CBM or CMM Project?

- Characteristics of successful CBM projects:
  - Thickness of coal
  - Gas content
  - Coal permeability
  - Gas prices
- Characteristics of successful CMM projects:
  - All of the above
  - Size of coal mine operations
  - Value of carbon credits or offsets

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Baseline Methodology

- Underground Mines
  - Emission reductions (ERs) generated when mining activities:
    - Bisect the vertical well's area of influence or effective radius (ACM0008)
    - Mine through or around the well (CCX)
  - In-mine horizontal pre-drainage wells treated like gob wells (ERs credited during the time of production)
  - No approved methodology for horizontal wells drilled from the surface

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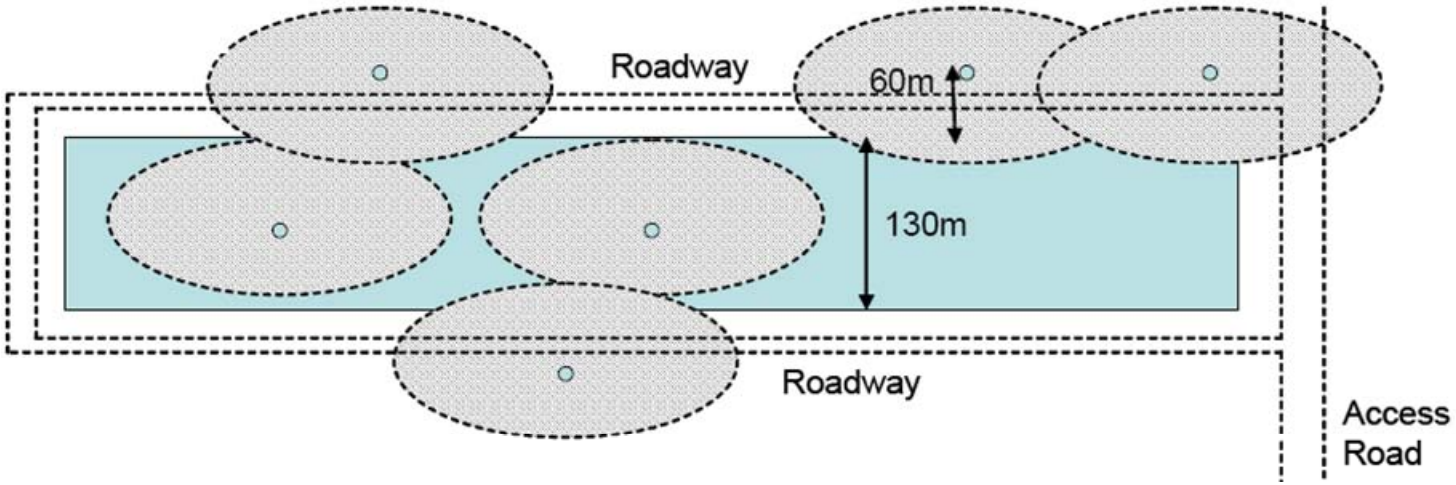
Baseline Methodology

- Underground Mines
  - ACM0008 methodology "*estimates the overlap between a cylindrical gas drainage zone around a production well with the zone of disturbance around a longwall panel, from which gas is emitted into the mine".*



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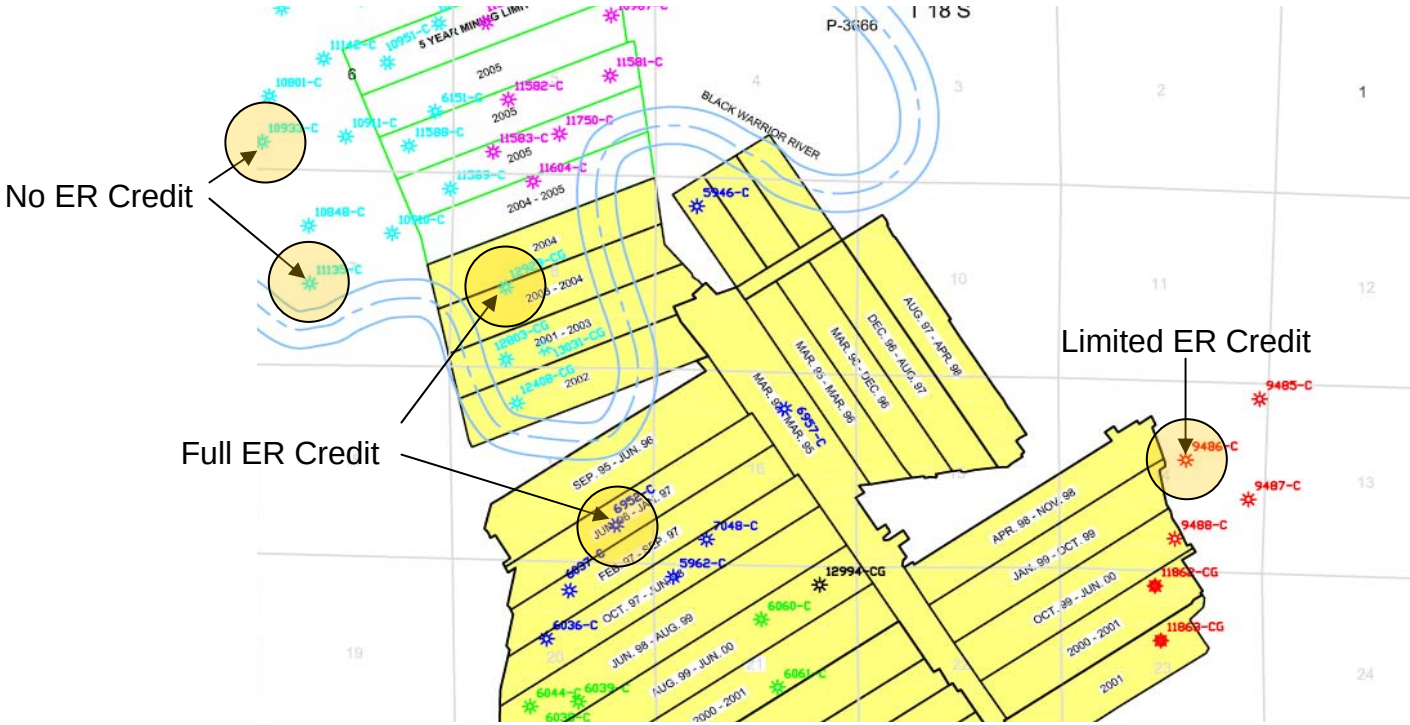
Baseline Methodology

- Example of Eligible Pre-Drainage Wells at Underground Mine in U.S.



Baseline Methodology

- Surface Mines
  - Emission reductions (ERs) generated when mining activities:
    - Cause the well to be shut in due to high concentrations of air from the highwall
    - Mining through or around the well not required
  - Pending VCS approval

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Powder River Basin Activities

- Home to the largest surface mines in the U.S.

Rank	Mine Names/Company	State	Production (short tons)
1	North Antelope Rochelle Mine/Powder River Coal, LLC	Wyoming	91,523,280
2	Black Thunder/Thunder Basin Coal Company LLC	Wyoming	86,196,275
3	Cordero Mine/Cordero Mining Company	Wyoming	40,467,627
4	Jacobs Ranch Mine/Jacobs Ranch Coal Company	Wyoming	38,101,560
5	Antelope Coal Mine/Antelope Coal Company	Wyoming	34,474,682
6	Caballo Mine/Caballo Coal Company	Wyoming	31,172,396
7	Belle Ayr Mine/Foundation Coal West Incorporated	Wyoming	26,608,765
8	Buckskin Mine/Triton Coal Company	Wyoming	25,268,145
9	Eagle Butte Mine/Foundation Coal West Incorporated	Wyoming	24,985,991
10	Rawhide Mine/Caballo Coal Company	Wyoming	17,144,361
11	Spring Creek Coal Company/Spring Creek Coal Company	Montana	15,712,091
12	Freedom Mine/Coteau Properties Company	North Dakota	14,955,989
13	Rosebud Mine & Crusher/Conveyor/Western Energy Company	Montana	12,583,084
14	Coal Creek Mine/Thunder Basin Coal Company LLC	Wyoming	10,216,194
15	Navajo Mine/BHP Navajo Coal Company	New Mexico	8,529,955
16	Kayenta Mine/Peabody Western Coal Company	Arizona	7,982,584
17	Falkirk Mine/Falkirk Mining Company	North Dakota	7,788,852
18	Absaloka Mine/Westmoreland Resources Inc.	Montana	7,704,556
19	Decker Mine/Decker Coal Company	Montana	6,984,546
20	Jewett Mine/Texas Westmoreland Coal Co.	Texas	6,779,166
21	Beckville Strip/Luminant Mining	Texas	6,172,298
22	Colowyo Mine/Colowyo Coal Company L P	Colorado	5,596,568
23	Lee Ranch Coal Company/Lee Ranch Coal Co. Div. Peabody	New Mexico	5,358,749
24	Dry Fork Mine/Western Fuels-Wyoming Inc	Wyoming	5,303,516
25	Kemmerer Mine/Chevron Mining Inc	Wyoming	5,190,147
26	Twilight MTR Surface Mine/Progress Coal	West Virginia	5,164,718
27	Wyodak/Wyodak Resources Development Co.	Wyoming	5,049,231

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Powder River Basin (Wyoming)

- Currently over 18,000 CBM wells producing 400 Bcf of methane annually
- Additional 6,000 wells planned

	2003	2010	2015	2020
Annual Production (BCF)	338	554	530	521
Active Wells	14,758	24,874	24,063	23,821

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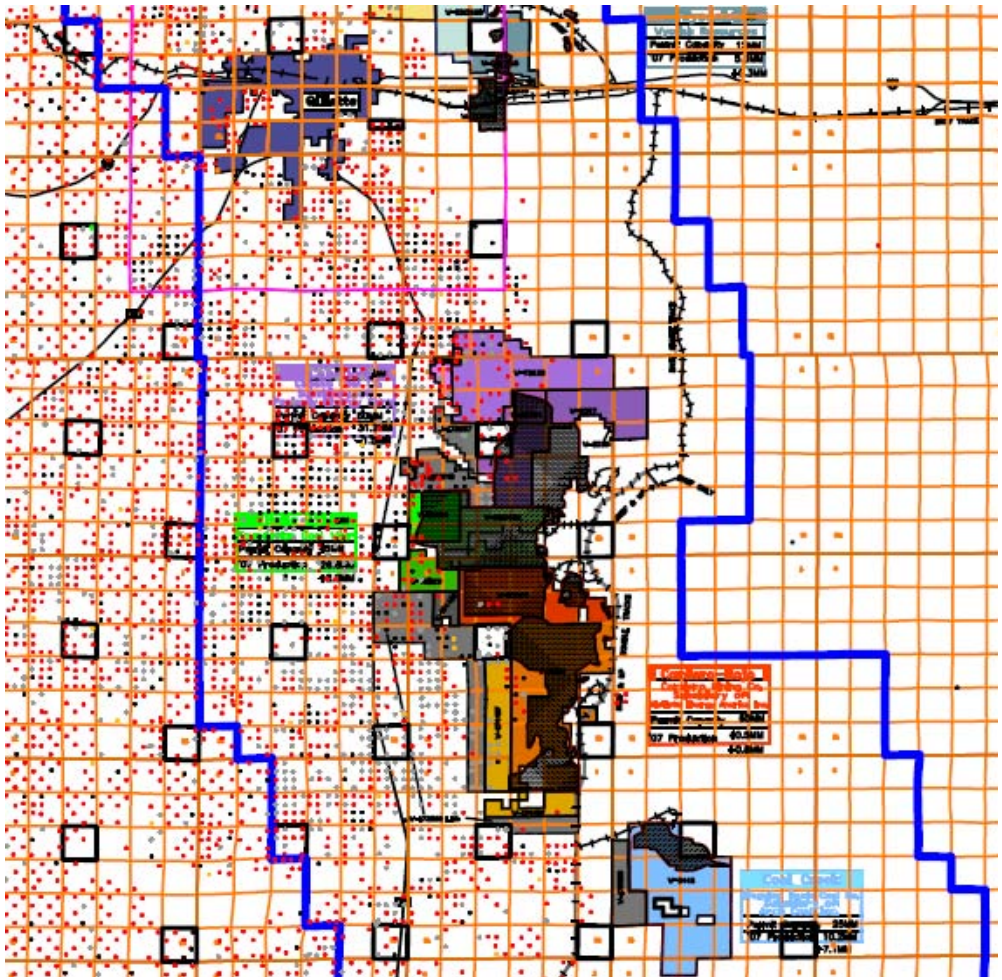
Powder River Basin (Wyoming)



Powder River Basin (Wyoming)

- Conflict Administration Zones
  - Regions located adjacent to the mines where coal mining activities and CBM production overlap
    - 10-yr mine out zone
  - Administered by U.S. BLM
    - Conflict Resolution
    - Cooperative Development Agreements
  - Contains over 2,500 CBM wells

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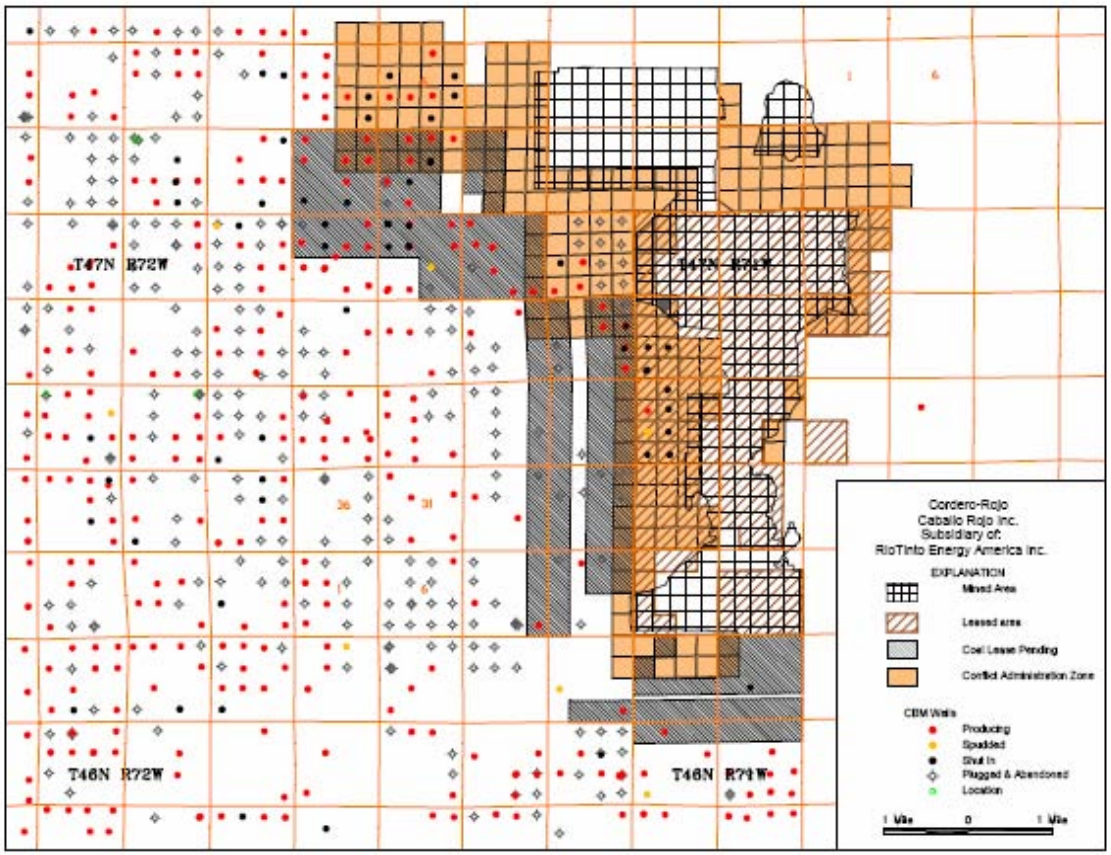
Powder River Basin (Wyoming)

- CAZ at Cordero-Rojo Mine



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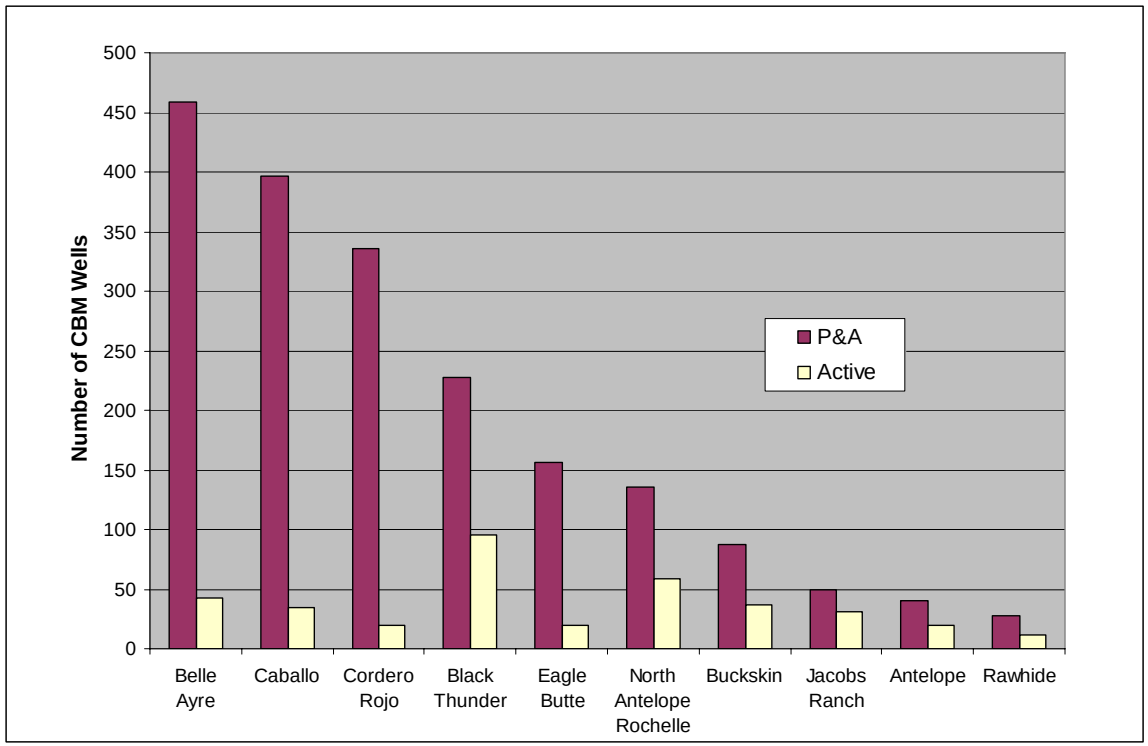
Powder River Basin (Wyoming)

- CBM Wells in CAZ regions of 10 largest mines in Wyoming



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Powder River Basin (Wyoming)

- Number of CBM Wells in CAZ Does Not Correspond to Size of Coal Mine
  - Possible reasons:
    - Gas rights issues
    - Competing oil production
    - Conservation easements
    - Conflicts with coal mine

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Powder River Basin Case Study

- Pre-Drainage Case Study
  - 47 wells drilled in CAZ in 2002
  - 40 acre spacing
  - Field placed on suction (500-1,300 hp)
  - 20 wells shut in by end of 2007
  - Average CH_4 concentration declines as highwall approaches
  - Wells shut in when highwall within ~2,500 ft.

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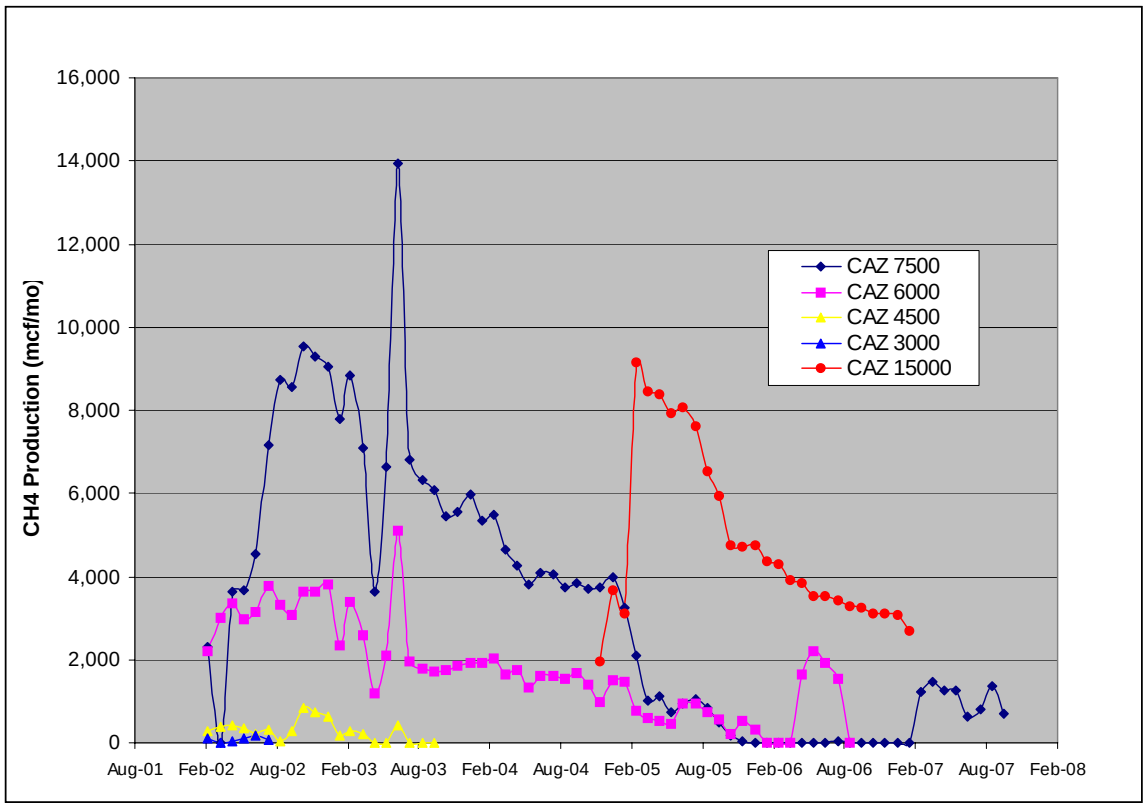
Powder River Basin Case Study

- Production vs. Distance from Mine Face



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Powder River Basin (Montana)

- Limited CBM Development Focused in South Central Region
- Currently, over 800 active CBM wells
- 5,000 wells planned over next decade

	2002	2003	2004	2005	2006
Gas Production (Mcf)					
South Central	11,103,921	8,492,510	13,598,459	12,881,341	13,065,601
Southeastern	314,136	287,241	256,582	196,211	177,262
Total Gas Production	**11,418,057**	**8,779,751**	**13,855,041**	**13,077,552**	**13,242,863**
No. of Producing Gas Wells					
South Central	292	378	486	569	835
Southeastern	7	7	7	7	22
Total Wells	**299**	**385**	**493**	**576**	**857**

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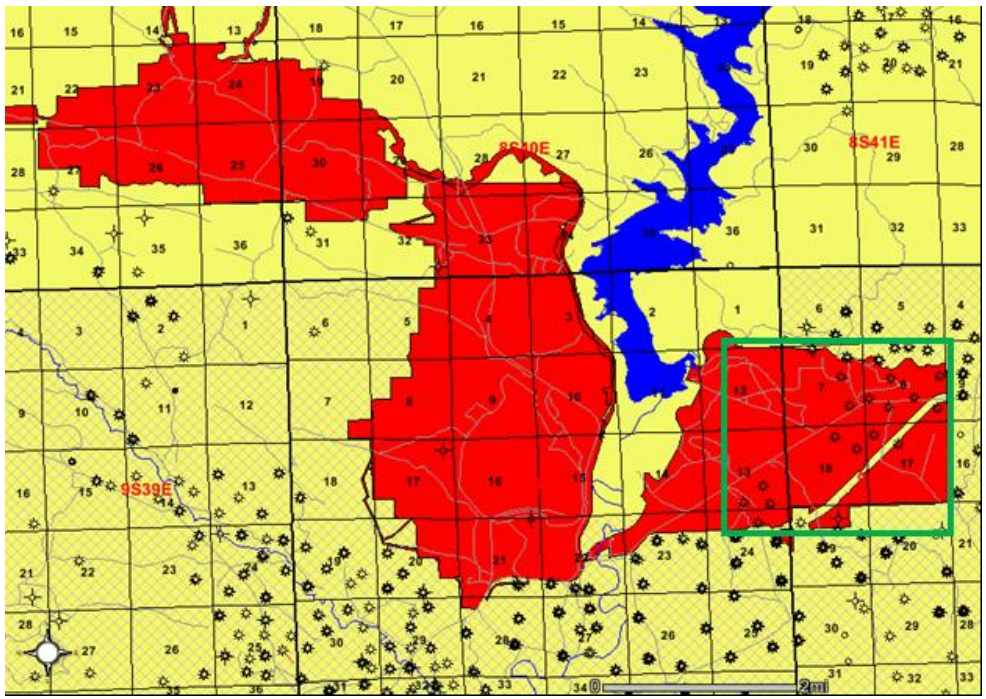
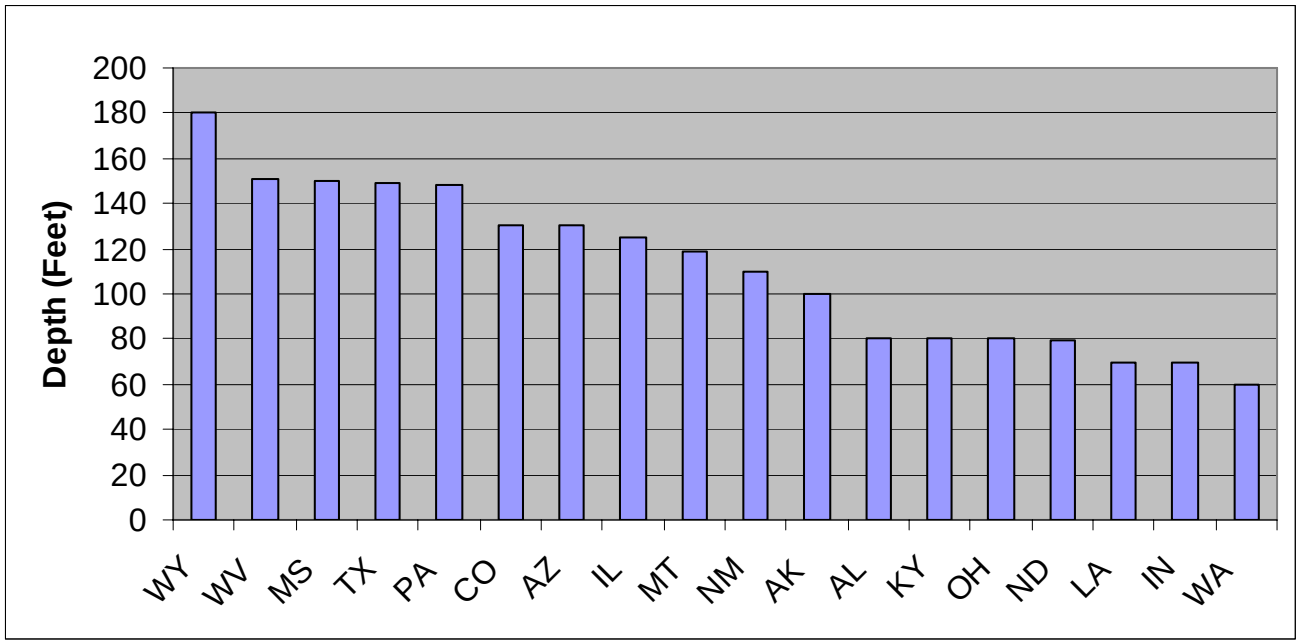
Powder River Basin (Montana)

- Currently No CAZ Regions
- Four large surface mine operations



Opportunities Outside the PRB

- Overburden Depths of Surface Mines in U.S.



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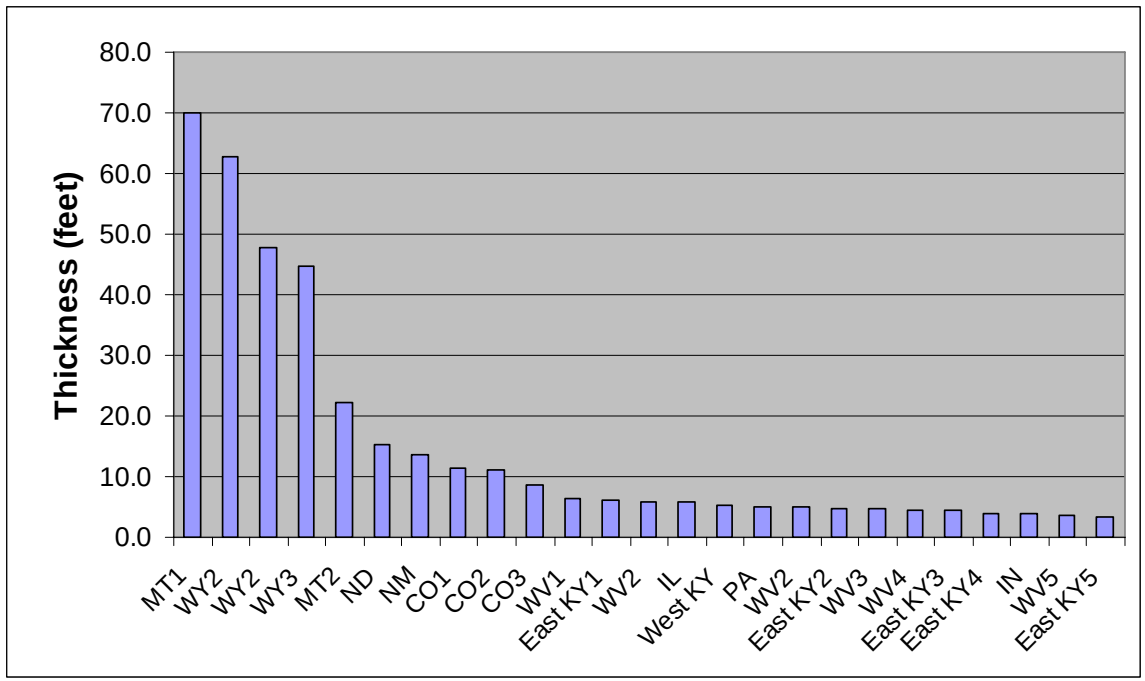
Opportunities Outside the PRB

- Coal Seam Thickness at Surface Mines in U.S.



Opportunities Outside the PRB

- Oklahoma
  - Arkoma Basin
  - Methane produced from shallow CBM wells (<500 ft.) during 1930s and 1940s
  - Coal gas content 35-75 scf/ton
  - Current production from wells 600-800 feet deep (near underground mines)

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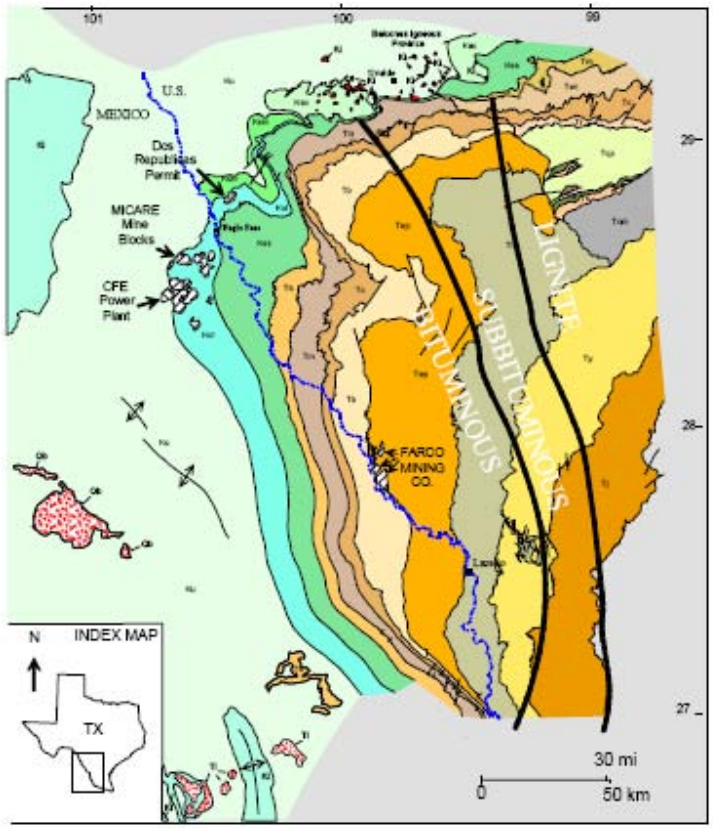
Opportunities Outside the PRB

- Texas
  - Most large surface operations mine lignite
  - Maverick County contains bituminous coals
  - CBM test wells 500-1500 feet deep
  - Eagle Pass Mine



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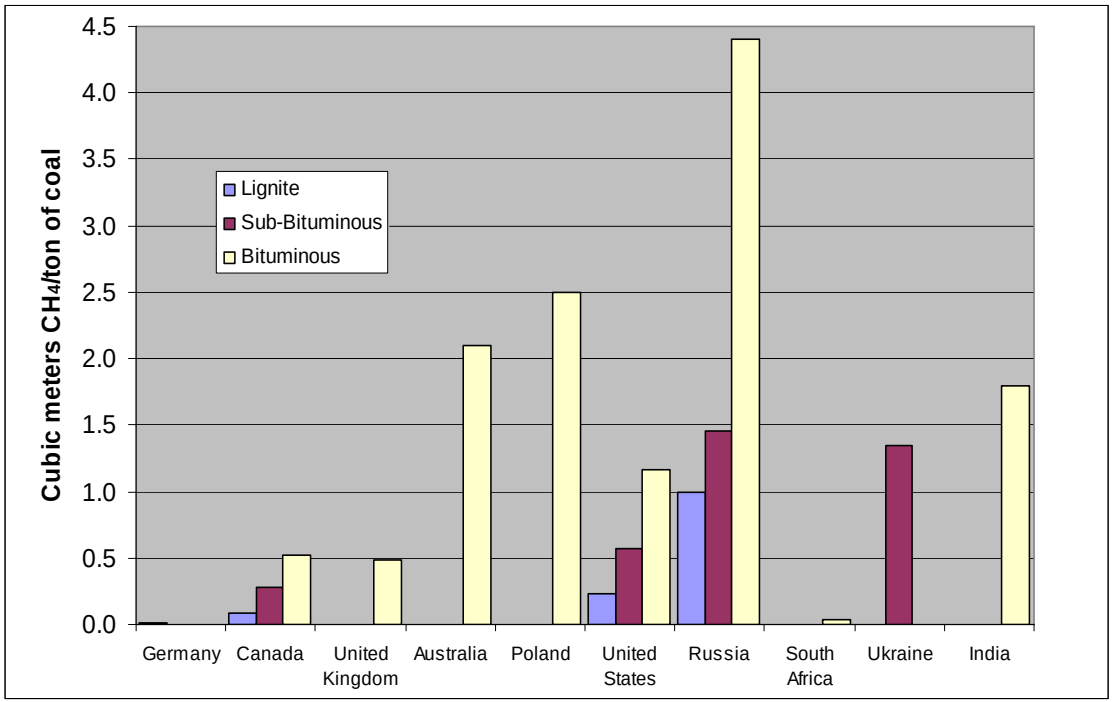
Opportunities Outside the PRB

- International



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Opportunities Outside the PRB

- International

Country	Shallow Coal Gas Content (ft3/ton)	% of Hard Coal that is Surface Mined	2005 Hard Coal Surface Mine Production (tons)
India	64	73%	290
Australia	42-113	78%	236
Indonesia	27	99%	126
Russia	40	51%	93
Kazakhstan	190	89%	82
Canada	20-28	99%	62
Colombia	40 (est)	90%	58
Powder River Basin	*20*	*100%*	*444*

Opportunities Outside the PRB

- International Case Study – Australia
  - Moura Mine (BHP Mitsui)
    - Began methane drainage at surface mine in 1996
    - Horizontal wells drilled 4500 ft. into coal seam
    - 5 years ahead of mining activities
    - Project produces 6 mmcf/day
  - Rio Tinto
    - Announced plans to drill 4 pilot wells in 2008
    - Two year test (flaring)

Conclusions

- A few opportunities may still remain at Wyoming mines
- CBM just beginning in Montana, but fewer mines
- May find unique opportunities in other western states:
  - Texas, Oklahoma, Colorado, New Mexico
- Opportunities exist in Australia and India

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Thank you!

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